

Finsler And Lagrange Geometries

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Finsler and Lagrange Geometries

In the last decade several international conferences on Finsler, Lagrange and Hamilton geometries were organized in Braşov, Romania (1994), Seattle, USA (1995), Edmonton, Canada (1998), besides the Seminars that periodically are held in Japan and Romania. All these meetings produced important progress in the field and brought forth the appearance of some reference volumes. Along this line, a new International Conference on Finsler and Lagrange Geometry took place August 26-31, 2001 at the "Al.I.Cuza" University in Iaşi, Romania. This Conference was organized in the framework of a Memorandum of Understanding (1994-2004) between the "Al.I.Cuza" University in Iaşi, Romania and the University of Alberta in Edmonton, Canada. It was especially dedicated to Prof. Dr. Peter Louis Antonelli, the liaison officer in the Memorandum, an untired promoter of Finsler, Lagrange and Hamilton geometries, very close to the Romanian School of Geometry led by Prof. Dr. Radu Miron. The dedication wished to mark also the 60th birthday of Prof. Dr. Peter Louis Antonelli. With this occasion a Diploma was given to Professor Dr. Peter Louis Antonelli conferring the title of Honorary Professor granted to him by the Senate of the oldest Romanian University (140 years), the "Al.I.Cuza" University, Iaşi, Romania. There were almost fifty participants from Egypt, Greece, Hungary, Japan, Romania, USA. There were scheduled 45 minutes lectures as well as short communications.

Lagrange and Finsler Geometry

The differential geometry of a regular Lagrangian is more involved than that of classical kinetic energy and consequently is far from being Riemannian. Nevertheless, such geometries are playing an increasingly important role in a wide variety of problems in fields ranging from relativistic optics to ecology. The present collection of papers will serve to bring the reader up-to-date on the most recent advances. Subjects treated include higher order Lagrange geometry, the recent theory of α -Lagrange manifolds, electromagnetic theory and neurophysiology. Audience: This book is recommended as a (supplementary) text in graduate courses in differential geometry and its applications, and will also be of interest to physicists and mathematical biologists.

Complex Spaces in Finsler, Lagrange and Hamilton Geometries

From a historical point of view, the theory we submit to the present study has its origins in the famous dissertation of P. Finsler from 1918 ([Fi]). In a the classical notion also conventional classification, Finsler geometry has besides a number of generalizations, which use the same work technique and which can be considered self-geometries: Lagrange and Hamilton spaces. Finsler geometry had a period of incubation long enough, so that few mathematicians (E. Cartan, L. Berwald, S.S. Chern, H. Rund) had the patience to penetrate into a universe of tensors, which made them compare it to a jungle. To all of us, who study nowadays Finsler geometry, it is obvious that the qualitative leap was made in the 1970's by the crystallization of the nonlinear connection notion (a notion which is almost as old as Finsler space, [SZ4]) and by work-skills into its adapted frame fields. The results obtained by M. Matsumoto (collected later, in 1986, in a monograph, [Ma3]) aroused interest not only in Japan, but also in other countries such as Romania, Hungary, Canada and the USA, where schools of Finsler geometry are founded and are presently widely recognized.

Finslerian Geometries

The International Conference on Finsler and Lagrange Geometry and its Applications: A Meeting of Minds, took place August 13-20, 1998 at the University of Alberta in Edmonton, Canada. The main objective of this meeting was to help acquaint North American geometers with the extensive modern literature on Finsler geometry and Lagrange geometry of the Japanese and European schools, each with its own venerable history, on the one hand, and to communicate recent advances in stochastic theory and Hodge theory for Finsler manifolds by the younger North American school, on the other. The intent was to bring together practitioners of these schools of thought in a Canadian venue where there would be ample opportunity to exchange information and have cordial personal interactions. The present set of refereed papers begins with the Pedagogical Section I, where introductory and brief survey articles are presented, one from the Japanese School and two from the European School (Romania and Hungary). These have been prepared for non-experts with the intent of explaining basic points of view. The Section III is the main body of work. It is arranged in alphabetical order, by author. Section II gives a brief account of each of these contributions with a short reference list at the end. More extensive references are given in the individual articles.

Differential Geometry of Finsler and Lagrange Spaces

Finsler geometry is a subject that concerns manifolds with Finsler metrics including Riemannian metrics. It has applications in many fields of natural sciences such as Biology, Econometrics, Physics etc. This invaluable book presents some advanced work done by the author in Finsler and Lagrange Geometry such as the theory of hyper surfaces with a beta change of Finsler metric, Cartan spaces with Generalized (α, β) -metric admitting h-metrical d-connection. In addition to above topics, four dimensional Finsler space with constant unified main scalars, conformal change of four dimensional Finsler space, a remarkable connection in a Finsler space with generalized (α, β) -metric, the existence of recurrent d-connections of the generalized Lagrange spaces and the L-duality between Finsler and Cartan spaces have been also discussed in detail. In particular the Finslerian hypersurfaces obtained by Matsumoto change of Finsler metric and the L-dual of Generalized Kropina metric have been discussed. This book will benefit the postgraduate students as well as researchers working in the field of Finsler, Lagrange Geometry and allied areas."

Lagrange and Finsler Geometry

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Finslerian Geometries

Differential-geometric methods are gaining increasing importance in the understanding of a wide range of fundamental natural phenomena. Very often, the starting point for such studies is a variational problem formulated for a convenient Lagrangian. From a formal point of view, a Lagrangian is a smooth real function defined on the total space of the tangent bundle to a manifold satisfying some regularity conditions. The main purpose of this book is to present: (a) an extensive discussion of the geometry of the total space of a vector bundle; (b) a detailed exposition of Lagrange geometry; and (c) a description of the most important applications. New methods are described for construction geometrical models for applications. The various chapters consider topics such as fibre and vector bundles, the Einstein equations, generalized Einstein--Yang--Mills equations, the geometry of the total space of a tangent bundle, Finsler and Lagrange spaces, relativistic geometrical optics, and the geometry of time-dependent Lagrangians. Prerequisites for using the book are a good foundation in general manifold theory and a general background in geometrical models in physics. For mathematical physicists and applied mathematicians interested in the theory and applications of differential-geometric methods.

The Geometry of Lagrange Spaces: Theory and Applications

The title of this book is no surprise for people working in the field of Analytical Mechanics. However, the geometric concepts of Lagrange space and Hamilton space are completely new. The geometry of Lagrange spaces, introduced and studied in [76],[96], was extensively examined in the last two decades by geometers and physicists from Canada, Germany, Hungary, Italy, Japan, Romania, Russia and U.S.A. Many international conferences were devoted to debate this subject, proceedings and monographs were published [10], [18], [112], [113],... A large area of applicability of this geometry is suggested by the connections to Biology, Mechanics, and Physics and also by its general setting as a generalization of Finsler and Riemannian geometries. The concept of Hamilton space, introduced in [105], [101] was intensively studied in [63], [66], [97],... and it has been successful, as a geometric theory of the Hamiltonian function the fundamental entity in Mechanics and Physics. The classical Legendre's duality makes possible a natural connection between Lagrange and Hamilton spaces. It reveals new concepts and geometrical objects of Hamilton spaces that are dual to those which are similar in Lagrange spaces. Following this duality Cartan spaces introduced and studied in [98], [99],..., are, roughly speaking, the Legendre duals of certain Finsler spaces [98], [66], [67]. The above arguments make this monograph a continuation of [106], [113], emphasizing the Hamilton geometry.

The Geometry of Hamilton and Lagrange Spaces

There are several mathematical approaches to Finsler Geometry, all of which are contained and expounded in this comprehensive Handbook. The principal pathway to state-of-the-art Finsler Theory is here provided by M. Matsumoto. His is a cornerstone for this set of essays, as are the articles of R. Miron (Lagrange Geometry) and J. Szilasi (Spray and Finsler Geometry). After studying either one of these, the reader will be able to understand the included survey articles on complex manifolds, holonomy, sprays and KCC-theory, symplectic structures, Legendre duality, Hodge theory and Gauss-Bonnet formulas. Finslerian diffusion theory is presented by its founders, P. Antonelli and T. Zastawniak. To help with calculations and conceptualizations, a CD-ROM containing the software package FINSLER, based on MAPLE, is included with the book.

The methods of differential geometry have been so completely merged nowadays with physical concepts that general relativity may well be considered to be a physical theory of the geometrical properties of space-time. The general relativity principles together with the recent development of Finsler geometry as a metric generalization of Riemannian geometry justify the attempt to systematize the basic techniques for extending general relativity on the basis of Finsler geometry. It is this endeavour that forms the subject matter of the present book. Our exposition reveals the remarkable fact that the Finslerian approach is automatically permeated with the idea of the unification of the geometrical space-time picture with gauge field theory - a circumstance that we try our best to elucidate in this book. The book has been written in such a way that the reader acquainted with the methods of tensor calculus and linear algebra at the graduate level can use it as a manual of Finslerian techniques orientable to applications in several fields. The problems attached to the chapters are also intended to serve this purpose. This notwithstanding, whenever we touch upon the Finslerian refinement or generalization of physical concepts, we assume that the reader is acquainted with these concepts at least at the level of the standard textbooks, to which we refer him or her.

Finsler Geometry, Relativity and Gauge Theories

In this book we study sprays and Finsler metrics. Roughly speaking, a spray on a manifold consists of compatible systems of second-order ordinary differential equations. A Finsler metric on a manifold is a family of norms in tangent spaces, which vary smoothly with the base point. Every Finsler metric determines a spray by its systems of geodesic equations. Thus, Finsler spaces can be viewed as special spray spaces. On the other hand, every Finsler metric defines a distance function by the length of minimal curves. Thus Finsler spaces can be viewed as regular metric spaces. Riemannian spaces are special regular metric spaces. In 1854, B. Riemann introduced the Riemann curvature for Riemannian spaces in his ground-breaking Habilitationsvortrag. Thereafter the geometry of these special regular metric spaces is named after him. Riemann also mentioned general regular metric spaces, but he thought that there were nothing new in the general case. In fact, it is technically much more difficult to deal with general regular metric spaces. For more than half century, there had been no essential progress in this direction until P. Finsler did his pioneering work in 1918. Finsler studied the variational problems of curves and surfaces in general regular metric spaces. Some difficult problems were solved by him. Since then, such regular metric spaces are called Finsler spaces. Finsler, however, did not go any further to introduce curvatures for regular metric spaces. He switched his research direction to set theory shortly after his graduation.

Differential Geometry of Spray and Finsler Spaces

This monograph is devoted to the problem of the geometrizing of Lagrangians which depend on higher-order accelerations. It presents a construction of the geometry of the total space of the bundle of the accelerations of order $k \geq 1$. A geometrical study of the notion of the higher-order Lagrange space is conducted, and the old problem of prolongation of Riemannian spaces to k -osculator manifolds is solved. Also, the geometrical ground for variational calculus on the integral of actions involving higher-order Lagrangians is dealt with. Applications to higher-order analytical mechanics and theoretical physics are included as well. Audience: This volume will be of interest to scientists whose work involves differential geometry, mechanics of particles and systems, calculus of variation and optimal control, optimization, optics, electromagnetic theory, and biology.

The Geometry of Higher-Order Lagrange Spaces

In the series of volumes which together will constitute the "Handbook of Differential Geometry" we try to give a rather complete survey of the field of differential geometry. The different chapters will both deal with the basic material of differential geometry and with research results (old and recent). All chapters are written by experts in the area and contain a large bibliography. In this second volume a wide range of areas in the very broad field of differential geometry is discussed, as there are Riemannian geometry, Lorentzian geometry, Finsler geometry, symplectic geometry, contact geometry, complex geometry, Lagrange geometry and the geometry of foliations. Although this does not cover the whole of differential geometry, the reader will be provided with an overview of some its most important areas. . Written by experts and covering recent research . Extensive bibliography . Dealing with a diverse range of areas . Starting from the basics

Handbook of Differential Geometry

This volume features proceedings from the 1995 Joint Summer Research Conference on Finsler Geometry, chaired by S. S. Chern and co-chaired by D. Bao and Z. Shen. The editors of this volume have provided comprehensive and informative "capsules" of presentations and technical reports. This was facilitated by classifying the papers into the following 6 separate sections - 3 of which are applied and 3 are pure: * Finsler Geometry over the reals * Complex Finsler geometry * Generalized Finsler metrics * Applications to biology, engineering, and physics * Applications to control theory * Applications to relativistic field theory Each section contains a preface that provides a coherent overview of the topic and includes an outline of the current directions of research and new perspectives. A short list of open problems concludes each contributed paper. A number of photos are featured in the volumes, for example, that of Finsler. In addition, conference participants are also highlighted.

Finsler Geometry

"Finsler Geometry: An Approach via Randers Spaces" exclusively deals with a special class of Finsler metrics -- Randers metrics, which are defined as the sum of a Riemannian metric and a 1-form. Randers metrics derive from the research on General Relativity Theory and have been applied in many areas of the natural sciences. They can also be naturally deduced as the solution of the Zermelo navigation problem. The book provides readers not only with essential findings on Randers metrics but also the core ideas and methods which are useful in Finsler geometry. It will be of significant interest to researchers and practitioners working in Finsler geometry, even in differential geometry or related natural fields. Xinyue Cheng is a Professor at the School of Mathematics and Statistics of Chongqing University of Technology, China. Zhongmin Shen is a Professor at the Department of Mathematical Sciences of Indiana University Purdue University, USA.

Finsler Geometry

This book is the first to present an overview of higher-order Hamilton geometry with applications to higher-order Hamiltonian mechanics. It is a direct continuation of the book *The Geometry of Hamilton and Lagrange Spaces*, (Kluwer Academic Publishers, 2001). It contains the general theory of higher order Hamilton spaces $H(k)n$, $k \geq 1$, semisprays, the canonical nonlinear connection, the N -linear metrical connection and their structure equations, and the Riemannian almost contact metrical model of these spaces. In addition, the volume also describes new developments such as variational principles for higher order Hamiltonians; Hamilton-Jacobi equations; higher order energies and law of conservation; Noether symmetries; Hamilton subspaces of order k and their fundamental equations. The duality, via Legendre transformation, between Hamilton spaces of order k and Lagrange spaces of the same order is pointed out. Also, the geometry of Cartan spaces of order $k = 1$ is investigated in detail. This theory is useful in the construction of geometrical models in theoretical physics, mechanics, dynamical systems, optimal control, biology, economy etc.

The Geometry of Higher-Order Hamilton Spaces

In 1854, B Riemann introduced the notion of curvature for spaces with a family of inner products. There was no significant progress in the general case until 1918, when P Finsler studied the variation problem in regular metric spaces. Around 1926, L Berwald extended Riemann's notion of curvature to regular metric spaces and introduced an important non-Riemannian curvature using his connection for regular metrics. Since then, Finsler geometry has developed steadily. In his Paris address in 1900, D Hilbert formulated 23 problems, the 4th and 23rd problems being in Finsler's category. Finsler geometry has broader applications in many areas of science and will continue to develop through the efforts of many geometers around the world. Usually, the methods employed in Finsler geometry involve very complicated tensor computations. Sometimes this discourages beginners. Viewing Finsler spaces as regular metric spaces, the author discusses the problems from the modern metric geometry point of view. The book begins with the basics on Finsler spaces, including the notions of geodesics and curvatures, then deals with basic comparison theorems on metrics and measures and their applications to the Levy concentration theory of regular metric measure spaces and Gromov's Hausdorff convergence theory. Contents: Finsler Spaces; Finsler m Spaces; Co-Area Formula; Isoperimetric Inequalities; Geodesics and Connection; Riemann Curvature; Non-Riemannian Curvatures; Structure Equations; Finsler Spaces of Constant Curvature; Second Variation Formula; Geodesics and Exponential Map; Conjugate Radius and Injectivity Radius; Basic Comparison Theorems; Geometry of Hypersurfaces; Geometry of Metric Spheres; Volume Comparison Theorems; Morse Theory of Loop Spaces; Vanishing

Theorems for Homotopy Groups; Spaces of Finsler Spaces. Readership: Graduate students and researchers in geometry and physics.

Lectures on Finsler Geometry

The aim of the present book is to give a systematic treatment of the inverse problem of the calculus of variations, i.e. how to recognize whether a system of differential equations can be treated as a system for extremals of a variational functional (the Euler-Lagrange equations), using contemporary geometric methods. Selected applications in geometry, physics, optimal control, and general relativity are also considered. The book includes the following chapters: - Helmholtz conditions and the method of controlled Lagrangians (Bloch, Krupka, Zenkov) - The Sonin-Douglas's problem (Krupka) - Inverse variational problem and symmetry in action: The Ostrogradskyj relativistic third order dynamics (Matsyuk.) - Source forms and their variational completion (Voicu) - First-order variational sequences and the inverse problem of the calculus of variations (Urban, Volna) - The inverse problem of the calculus of variations on Grassmann fibrations (Urban).

The Inverse Problem of the Calculus of Variations

This comprehensive book is an introduction to the basics of Finsler geometry with recent developments in its area. It includes local geometry as well as global geometry of Finsler manifolds. In Part I, the authors discuss differential manifolds, Finsler metrics, the Chern connection, Riemannian and non-Riemannian quantities. Part II is written for readers who would like to further their studies in Finsler geometry. It covers projective transformations, comparison theorems, fundamental group, minimal immersions, harmonic maps, Einstein metrics, conformal transformations, amongst other related topics. The authors made great efforts to ensure that the contents are accessible to senior undergraduate students, graduate students, mathematicians and scientists.

Introduction to Modern Finsler Geometry

This is a comprehensive exposition of topics covered by the American Mathematical Society's classification "Global Analysis", dealing with modern developments in calculus expressed using abstract terminology. It will be invaluable for graduate students and researchers embarking on advanced studies in mathematics and mathematical physics. This book provides a comprehensive coverage of modern global analysis and geometrical mathematical physics, dealing with topics such as; structures on manifolds, pseudogroups, Lie groupoids, and global Finsler geometry; the topology of manifolds and differentiable mappings; differential equations (including ODEs, differential systems and distributions, and spectral theory); variational theory on manifolds, with applications to physics; function spaces on manifolds; jets, natural bundles and generalizations; and non-commutative geometry. - Comprehensive coverage of modern global analysis and geometrical mathematical physics- Written by world-experts in the field- Up-to-date contents

Handbook of Global Analysis

This book illustrates the broad range of Jerry Marsden's mathematical legacy in areas of geometry, mechanics, and dynamics, from very pure mathematics to very applied, but always with a geometric perspective. Each contribution develops its material from the viewpoint of geometric mechanics beginning at the very foundations, introducing readers to modern issues via illustrations in a wide range of topics. The twenty refereed papers contained in this volume are based on lectures and research performed during the month of July 2012 at the Fields Institute for Research in Mathematical Sciences, in a program in honor of Marsden's legacy. The unified treatment of the wide breadth of topics treated in this book will be of interest to both experts and novices in geometric mechanics. Experts will recognize applications of their own familiar concepts and methods in a wide variety of fields, some of which they may never have approached from a geometric viewpoint. Novices may choose topics that interest them among the various fields and learn about geometric approaches and perspectives toward those topics that will be new for them as well.

Geometry, Mechanics, and Dynamics

This book begins with a new approach to the geometry of pseudo-Finsler manifolds. It also discusses the geometry of pseudo-Finsler manifolds and presents a comparison between the induced and the intrinsic Finsler connections. The Cartan, Berwald, and Rund connections are all investigated.

Included also is the study of totally geodesic and other special submanifolds such as curves, surfaces, and hypersurfaces. Audience: The book will be of interest to researchers working on pseudo-Finsler geometry in general, and on pseudo-Finsler submanifolds in particular.

Geometry of Pseudo-Finsler Submanifolds

Finslerian Laplacians have arisen from the demands of modelling the modern world. However, the roots of the Laplacian concept can be traced back to the sixteenth century. Its phylogeny and history are presented in the Prologue of this volume. The text proper begins with a brief introduction to stochastically derived Finslerian Laplacians, facilitated by applications in ecology, epidemiology and evolutionary biology. The mathematical ideas are then fully presented in section II, with generalizations to Lagrange geometry following in section III. With section IV, the focus abruptly shifts to the local mean-value approach to Finslerian Laplacians and a Hodge-de Rham theory is developed for the representation on real cohomology classes by harmonic forms on the base manifold. Similar results are proved in sections II and IV, each from different perspectives. Modern topics treated include nonlinear Laplacians, Bochner and Lichnerowicz vanishing theorems, Weitzenböck formulas, and Finslerian spinors and Dirac operators. The tools developed in this book will find uses in several areas of physics and engineering, but especially in the mechanics of inhomogeneous media, e.g. Cofferat continua. Audience: This text will be of use to workers in stochastic processes, differential geometry, nonlinear analysis, epidemiology, ecology and evolution, as well as physics of the solid state and continua.

The Theory of Finslerian Laplacians and Applications

This book provides a comprehensive introduction to Finsler geometry in the language of present-day mathematics. Through Finsler geometry, it also introduces the reader to other structures and techniques of differential geometry. Prerequisites for reading the book are minimal: undergraduate linear algebra (over the reals) and analysis. The necessary concepts and tools of advanced linear algebra (over modules), point set topology, multivariable calculus and the rudiments of the theory of differential equations are integrated in the text. Basic manifold and bundle theories are treated concisely, carefully and (apart from proofs) in a self-contained manner. The backbone of the book is the detailed and original exposition of tangent bundle geometry, Ehresmann connections and sprays. It turns out that these structures are important not only in their own right and in the foundation of Finsler geometry, but they can be also regarded as the cornerstones of the huge edifice of Differential Geometry. The authors emphasize the conceptual aspects, but carefully elaborate calculative aspects as well (tensor derivations, graded derivations and covariant derivatives). Although they give preference to index-free methods, they also apply the techniques of traditional tensor calculus. Most proofs are elaborated in detail, which makes the book suitable for self-study. Nevertheless, the authors provide for more advanced readers as well by supplying them with adequate material, and the book may also serve as a reference.

Combinatorial Geometry with Applications to Field Theory, Second Edition, graduate textbook in mathematics

Complex Finsler metrics appear naturally in complex analysis. To develop new tools in this area, the book provides a graduate-level introduction to differential geometry of complex Finsler metrics. After reviewing real Finsler geometry stressing global results, complex Finsler geometry is presented introducing connections, Kählerianity, geodesics, curvature. Finally global geometry and complex Monge-Ampère equations are discussed for Finsler manifolds with constant holomorphic curvature, which are important in geometric function theory. Following E. Cartan, S.S. Chern and S. Kobayashi, the global approach carries the full strength of hermitian geometry of vector bundles avoiding cumbersome computations, and thus fosters applications in other fields.

The Geometry of Hamilton and Lagrange Spaces

Develops the theory of jet single-time Lagrange geometry and presents modern-day applications Jet Single-Time Lagrange Geometry and Its Applications guides readers through the advantages of jet single-time Lagrange geometry for geometrical modeling. With comprehensive chapters that outline topics ranging in complexity from basic to advanced, the book explores current and emerging applications across a broad range of fields, including mathematics, theoretical and atmospheric physics, economics, and theoretical biology. The authors begin by presenting basic theoretical concepts that serve as the foundation for understanding how and why the discussed theory works. Subsequent

chapters compare the geometrical and physical aspects of jet relativistic time-dependent Lagrange geometry to the classical time-dependent Lagrange geometry. A collection of jet geometrical objects are also examined such as d-tensors, relativistic time-dependent semisprays, harmonic curves, and nonlinear connections. Numerous applications, including the gravitational theory developed by both the Berwald-Moór metric and the Chernov metric, are also presented. Throughout the book, the authors offer numerous examples that illustrate how the theory is put into practice, and they also present numerous applications in which the solutions of first-order ordinary differential equation systems are regarded as harmonic curves on 1-jet spaces. In addition, numerous opportunities are provided for readers to gain skill in applying jet single-time Lagrange geometry to solve a wide range of problems. Extensively classroom-tested to ensure an accessible presentation, *Jet Single-Time Lagrange Geometry and Its Applications* is an excellent book for courses on differential geometry, relativity theory, and mathematical models at the graduate level. The book also serves as an excellent reference for researchers, professionals, and academics in physics, biology, mathematics, and economics who would like to learn more about model-providing geometric structures.

Connections, Sprays and Finsler Structures

The present monograph is motivated by two distinct aims. Firstly, an endeavour has been made to furnish a reasonably comprehensive account of the theory of Finsler spaces based on the methods of classical differential geometry. Secondly, it is hoped that this monograph may serve also as an introduction to a branch of differential geometry which is closely related to various topics in theoretical physics, notably analytical dynamics and geometrical optics. With this second object in mind, an attempt has been made to describe the basic aspects of the theory in some detail - even at the expense of conciseness - while in the more specialised sections of the later chapters, which might be of interest chiefly to the specialist, a more succinct style has been adopted. The fact that there exist several fundamentally different points of view with regard to Finsler geometry has rendered the task of writing a coherent account a rather difficult one. This remark is relevant not only to the development of the subject on the basis of the tensor calculus, but is applicable in an even wider sense. The extensive work of H. BUSEMANN has opened up new avenues of approach to Finsler geometry which are independent of the methods of classical tensor analysis. In the latter sense, therefore, a full description of this approach does not fall within the scope of this treatise, although its fundamental significance cannot be doubted.

An Introduction to Finsler Geometry

This book presents properties, examples, rigidity theorems and classification results of such Finsler metrics. In particular, this book introduces how to investigate spherically symmetric Finsler geometry using ODE or PDE methods. Spherically symmetric Finsler geometry is a subject that concerns domains in R^n with spherically symmetric metrics. Recently, a significant progress has been made in studying Riemannian-Finsler geometry. However, constructing nice examples of Finsler metrics turn out to be very difficult. In spherically symmetric Finsler geometry, we find many nice examples with special curvature properties using PDE technique. The studying of spherically symmetric geometry shows closed relation among geometry, group and equation.

Finsler Metrics - A Global Approach

The mathematical combinatorics is a subject that applying combinatorial notion to all mathematics and all sciences for understanding the reality of things in the universe, motivated by CC Conjecture of Dr. Linfan MAO on mathematical sciences. The Mathematical Combinatorics (International Book Series) is a fully refereed international book series with an ISBN number on each issue, sponsored by the MADIS of Chinese Academy of Sciences and published in USA quarterly, which publishes original research papers and survey articles in all aspects of mathematical combinatorics, Smarandache multi-spaces, Smarandache geometries, non-Euclidean geometry, topology and their applications to other sciences.

Jet Single-Time Lagrange Geometry and Its Applications

We learn about the universe by two ways: experience and observation & thought and deduction. In practice, we get most of our knowledge by continually combining observations with deductions. It is possible subsequently to formulate certain types of knowledge by pure deduction, starting from a set of axioms. The advantage of deductive method is that its conclusions are certain and it also obtained where scope of observation is very limited. As we are three dimensional living being, we cannot imagine any geometrical picture more than three dimensions; only we have projection of higher dimensional

pictures in two and three dimensions. In the deductive reasoning, we can logically extend our arguments from one dimension to a number of dimensions. An example of deductive method is Euclidian geometry whose postulates are certain definitions and axioms concerning points, lines etc; and from these a logical chain of theorems concerning lines, angles, triangles etc are deduced. In modern times Euclidean geometric concepts have been extended in many branches, viz: Non-Euclidean geometry, Riemannian geometry, Finsler geometry and Lagrange geometry.

Algebras, Groups, and Geometries

This book constitutes the thoroughly refereed post-conference proceedings of the 13th International Conference on Security for Information Technology and Communications, SecITC 2020, held in Bucharest, Romania, in November 2020. The 17 revised full papers presented together with 2 invited talks were carefully reviewed and selected from 41 submissions. The conference covers topics from cryptographic algorithms, to digital forensics and cyber security and much more.

The Differential Geometry of Finsler Spaces

Geometric Mechanics here means mechanics on a pseudo-riemannian manifold and the main goal is the study of some mechanical models and concepts, with emphasis on the intrinsic and geometric aspects arising in classical problems. The first seven chapters are written in the spirit of Newtonian Mechanics while the last two ones as well as two of the four appendices describe the foundations and some aspects of Special and General Relativity. All the material has a coordinate free presentation but, for the sake of motivation, many examples and exercises are included in order to exhibit the desirable flavor of physical applications.

The Geometry of Spherically Symmetric Finsler Manifolds

This book focuses on the elementary but essential problems in Riemann-Finsler Geometry, which include a repertoire of rigidity and comparison theorems, and an array of explicit examples, illustrating many phenomena which admit only Finslerian interpretations. "This book offers the most modern treatment of the topic ..." EMS Newsletter.

MATHEMATICAL COMBINATORICS (INTERNATIONAL BOOK SERIES)

Investigations on Special Finsler Spaces